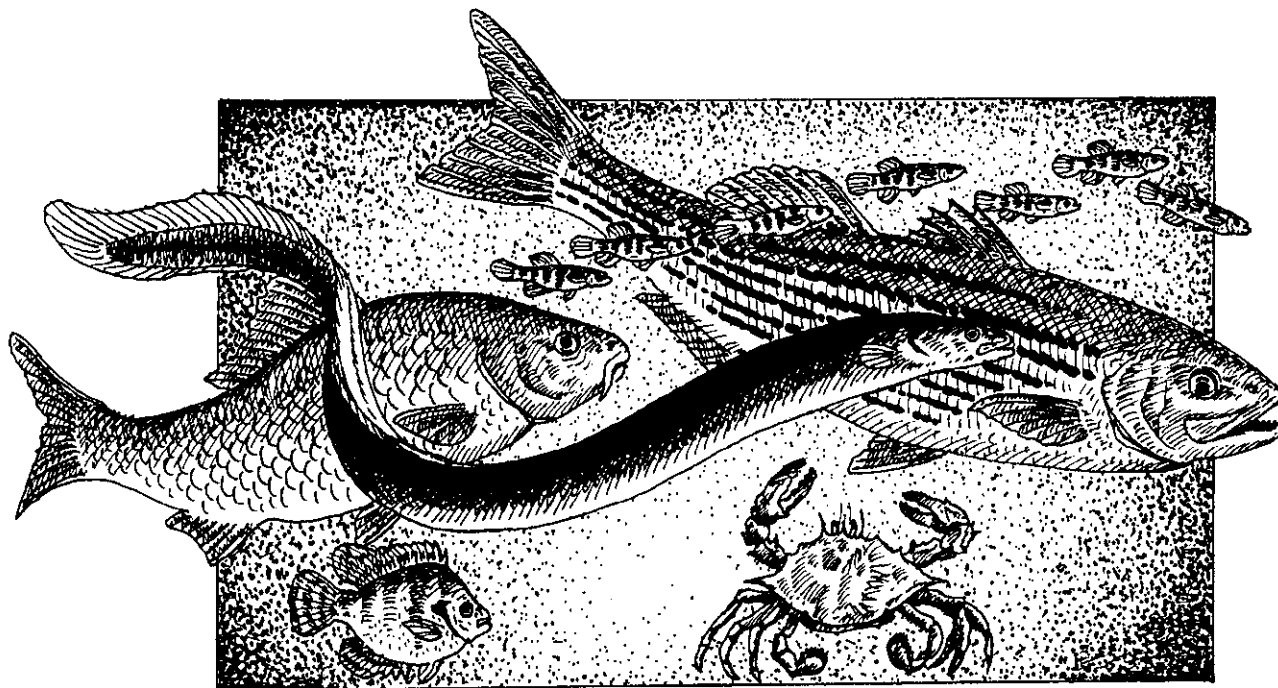


A CLOSER LOOK



SECTION 3 THE NEWARK BAY COMPLEX, *TEEMING WITH LIFE*

As long as people have inhabited the areas within the Newark Bay Complex, there has been a focus on the waterways and the living resources within those waterways. Fish, crabs, oysters, eels, shellfish and other aquatic animals have provided food and a livelihood for countless people. But, throughout the centuries, there has been concern about how pollution was affecting these very resources. For example, by the 1920s, the oyster industry in the New York/New Jersey Harbor Estuary was closed because of bacterial contamination from human sewage.¹

Although commercial fishing is now banned from the Newark Bay Complex waters, people continue to catch fish from these waters for sport and to supplement their diet. In 2001, the U.S. Fish and Wildlife Service estimated a total of 806,000 anglers fishing New Jersey's waters.² No matter what age you are or whether you "catch and release" or "catch and keep," the thrill of the catch is the same. But for those who catch and keep, it is important to know the waters where you fish and to be aware of state fish consumption advisories. This is particularly true of New Jersey's urban rivers and bays, where pollution has caused the water to become contaminated with toxic chemicals that are harmful to fish – and may be harmful to the people who eat them.

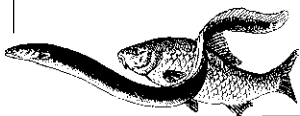


The most popular saltwater fish species sought by these anglers include fluke (summer flounder), bluefish, striped bass, sea bass, winter flounder, scup, porgy, weakfish and tautog (blackfish). From that list, bluefish and striped bass are included on the state's Fish Consumption Advisories list (Appendix A) along with white perch, American eel, blue crab and white catfish. The New Jersey Department of Environmental Protection, Division of Science, Research and Technology identified these six species as those that may contain unsafe levels of dioxins and polychlorinated biphenyls (PCBs). These man-made chemicals are classified by the U.S. Environmental Protection Agency as probable cancer-causing substances in humans.

For decades, industries and municipalities discharged wastes directly into the region's waterways. Although production and discharge of these contaminants is no longer permitted, persistent contaminants, such as PCBs and dioxins, remain in the sediments in the estuary and its tributaries. Storms and dredging continue to disturb this lower layer, and bottom-feeding organisms directly ingest the contaminants. These organisms become a food source for fish and crabs and the contaminants become accumulated in these higher order consumers in greater concentration. Despite all of this, there are thousands of people in the Newark Bay Complex who enjoy angling in its waters. In 2001, New Jersey anglers spent approximately \$841 million, and in cases where the fisheries have been managed well and resources are productive there continues to be a strong ecotourism industry.²

There are generally three categories of anglers in the Newark Bay Complex. According to Beatrice Bernzot from New Jersey Concern, the first group of anglers have traditionally fished, crabbed and eaten their catch their whole lives and their families have done the same. These people simply do not believe there is a problem with the fish because they have never gotten sick, and no one in their family is sick. The second group is those who fish and crab as part of a cultural tradition – it is a way of life for them, and the third group fish and crab to put food on the table.³ All anglers are encouraged to become familiar with the guidelines outlined in the Fish Consumption Advisories. These guidelines help anglers who eat their catch, reducing the likelihood of long-term health problems due to ingesting the contaminants found in the Advisory species. Suggestions are given as to how often one should eat these fish, who should not eat these fish (pregnant women / young children), what size the fish should be, and how to prepare the fish or crab.

The Fish Consumption Advisories are not intended to discourage anglers from fishing, but are designed to educate anglers and the general public about potential health problems associated with the regular ingestion of specific fish species. Often chemical contamination is odorless and shows no noticeable defects in the organism. The lack of any overt "problems" with an affected species makes it difficult to convince people of potential health impacts.



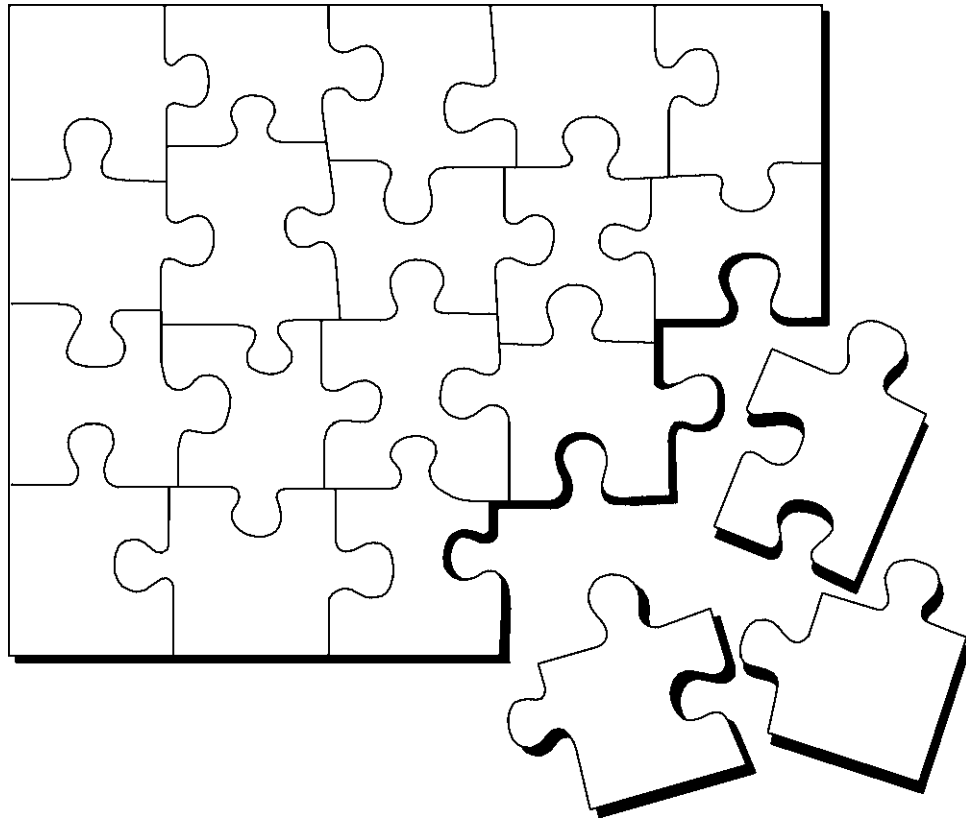
¹ NY/NJ Harbor Estuary Program newsletter.

² US Fish and Wildlife Service, 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, issued June 2002.

³ Beatrice Bernzot, director of New Jersey Concern, Linden, NJ



FISH PUZZLE RELAY



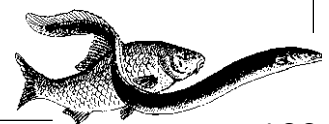
BACKGROUND INFORMATION



An animal's shape, color and markings complement its lifestyle. Coloration and markings aid in camouflage, concealment, recognition and spawning, while an animal's shape and overall manner lend insight into the animal's habits.

Most fish are dark on top and light on the belly. This combination makes it more difficult for a predator to see the fish. From above, it looks dark like the deep water and from below, it looks light like the sky.

Bottom dwelling fish and aquatic animals usually are mottled and camouflaged and look like the composition of mud or sand on which they live. Vegetation dwellers tend to be striped or splotched, which makes them blend in with dappled sunlight. Most open-water fish are more white and silver and reflect the shimmering water. Bright colors may benefit fish in finding mates and be a signal of danger to predators.



LEVEL

4 and 5

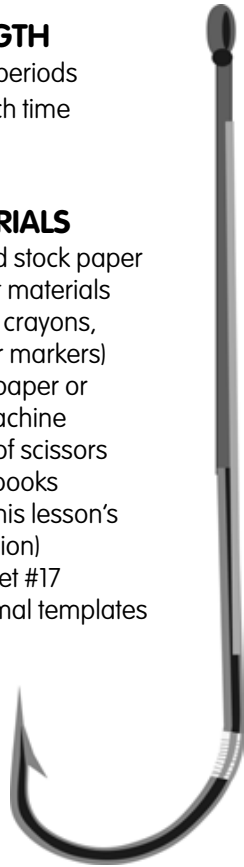
LENGTH

2 class periods
research time



MATERIALS

- o oaktag or card stock paper
- o a variety of art materials (suggestions: crayons, paints, and/or markers)
- o clear contact paper or laminating machine
- o several pairs of scissors
- o identification books (listed under this lesson's reference section)
- o Discovery Sheet #17
- o estuarine animal templates (Figures 11B-I)



OVERVIEW

Awareness of an aquatic animal's characteristics leads to an understanding of the animal's identification, behavior, and habitat.

OBJECTIVES

Students will:



Identify various species of estuarine creatures;



Identify the Fish Advisory species;



Describe how colors and patterns help animals survive in their habitat.



ADVISORY LINK

Each species of estuarine animal is identifiable by looking at the animal's shape, color, markings, and the habitat in which it is found. Recreational anglers should learn to recognize the species that are listed in the Fish Consumption Advisories because the consumption of these species may pose potential health risks.

KEYWORDS

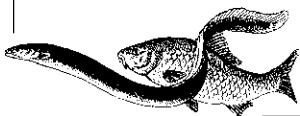
adaptation
camouflage
estuary

STUDENT PREREQUISITES

None

PROCESS SKILLS

observing
formulating hypotheses
communicating
analyzing
categorizing
synthesizing



PLANNING



1. Assemble the art materials and identification books.
2. Copy estuarine animal templates (Figures 11B-K) onto oaktag or card stock. Make enough for each student to have one.
3. Color, identify, laminate and cut at least two extra animal puzzles (or have a student do this for you).
4. Determine a site for a relay race.

PROCEDURE SETTING THE STAGE

Ask the students where they have been or what they have been doing to see different kinds of fish [*aquarium, zoo, lake, estuary, photographs, books, television, snorkeling, glass bottom boat*]. Have various students describe some of the fish they have seen. Write these descriptions on the board. Have the students explain why the listed species have different descriptions.

THE ACTION



Period 1

1. Write the names of the animals (Figure 11A) on the board. Have each student select one animal.
2. Provide students with reference materials or allow them time to go to the library to research their animals and complete Discovery Sheet #17. This research will allow them to become an "expert" on their species.
3. Distribute an oaktag outline of their animal for students to color.
4. Have the students cut out the drawings and on the back of each have the student write his/her name, the name of the animal, and the animal's habitat.
5. Laminate the drawings or have the students cover each with clear contact paper.
6. Cut the drawing into four jigsaw pieces. Set one piece from each puzzle aside in a pile and mix the rest of the pieces together.

Period 2

1. Divide the class into three teams to play a puzzle relay race.
2. Give each student one puzzle piece that is not his/her own. Place the remaining pieces (face-up) at the other end of the gym or field. *NOTE: Include your extra puzzle pieces to make it more challenging for the last few students to find their own pieces.
3. Explain the rules:
 - On your signal, the first student from each team runs to the other pieces and collects one piece that fits his or her puzzle.
 - The student runs back, tags the next student, then goes to the end of the line.
4. Continue play until one team finishes and sits down.
5. Have each student hold up his/her completed puzzle and give the name of the animal, the information from the back of the puzzle and hypothesize why the animal is colored or patterned the way it is.



CLOSING DISCUSSION

1. What characteristics (physical adaptations) do bottom dwellers have in common?
[dark on top, light on the bottom, brown and gray colors, mottling] vegetation dwellers? [stripes and splotches to simulate shadows and sun dappling] open water fish? [silver and white colors]
2. How do you think these variations help the animals? *[create camouflage, help in breeding, help predators catch their prey.]*
3. Which of these animals have you seen and in what circumstances?

EXTENSION ESTUARY GO-FISH

Cover the back of each puzzle to hide the written information. Mix all the puzzle pieces together and turn them upside down in a pile. Have each student in the small group draw five pieces. The rest of the pieces remain in a center pile. Have the students take turns asking other players for the pieces that they need or by drawing from the center pile. Needs should be based on describing the colors and patterns. If another player provides a possible puzzle piece, the asker gets to see if it fits. If it does, the asker gets to keep it to work on finishing the puzzle that, upon completion, is laid down on the table and identified. If it does not fit, the card can be kept or placed in the discard pile. The first player to use up all their cards is the winner.

FIGURE 11A

ESTUARINE CREATURES OF THE NEWARK BAY COMPLEX

BOTTOM DWELLERS

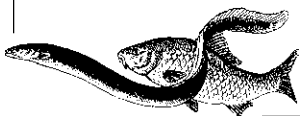
Blue Crab
White Catfish
American Eel
Winter Flounder
Fluke (Summer Flounder)

OPEN WATER FISH

Bluefish
White Perch
Striped Bass
Weakfish

VEGETATION DWELLERS

Killifish
Tautog (Blackfish) - juveniles only



ASSESSMENT STRATEGIES

Have the students:

- ❑ Demonstrate recognition of the listed species by using the puzzles as flashcards to quiz each other. (Use velcro on the back of each piece and affix to material-covered poster board.) Work in small groups to create a section of a wall mural that depicts how the animals use their adaptations to survive in the estuary ecosystem. Highlight the Fish Advisory species on the mural.

STAYING INVOLVED



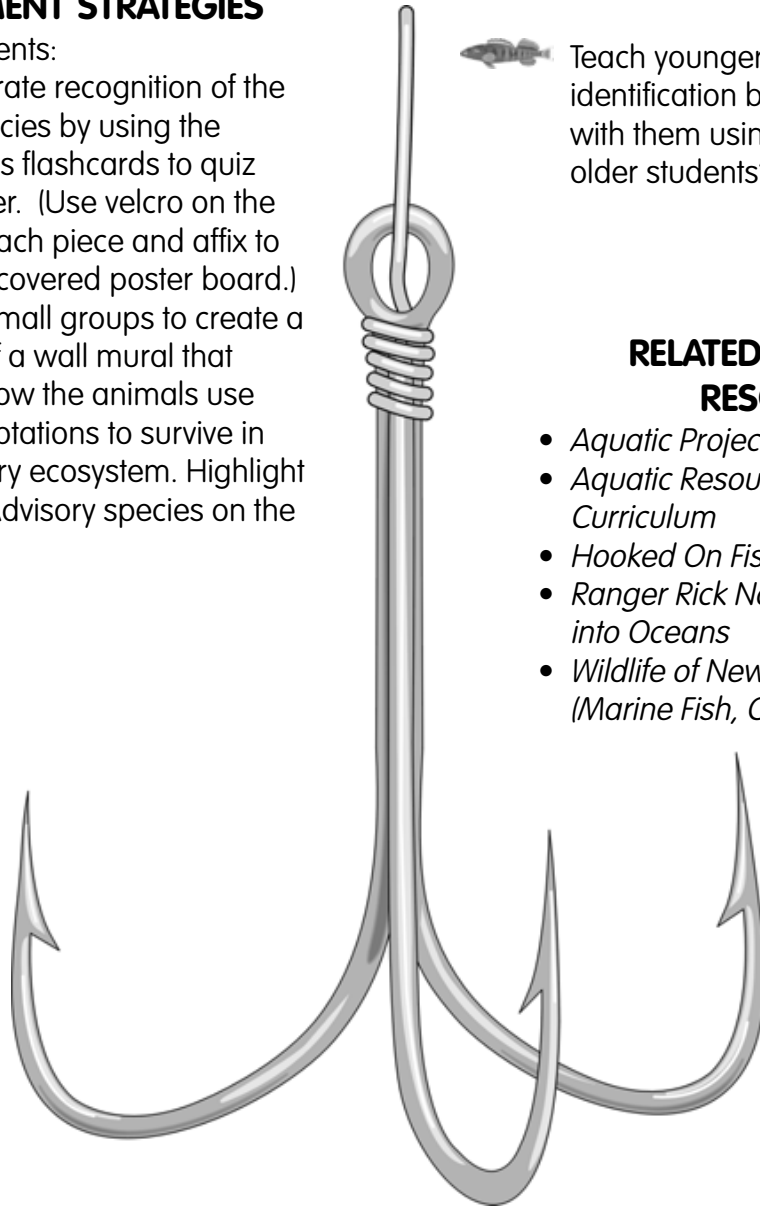
Display the students' mural (mentioned in assessment strategies) in a public place along with information about the Fish Consumption Advisories.



Teach younger children fish identification by playing the game with them using the older students' puzzles.

RELATED EDUCATION RESOURCES

- *Aquatic Project WILD*
- *Aquatic Resources Education Curriculum*
- *Hooked On Fishing - Not On Drugs*
- *Ranger Rick NatureScope - Diving into Oceans*
- *Wildlife of New Jersey Posters (Marine Fish, General Marine Life)*



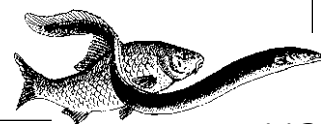
REFERENCE

AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.

McClane, A.J. *McClane's Field Guide to Saltwater Fish of North America*. Henry Holt and Company, New York. 1974.

New Jersey Marine Sciences Consortium. *The Hook Book: A Guide to Common Marine Organisms of Sandy Hook*. Sandy Hook, NJ. 1987.

Robins, Ray, and Douglass. *Peterson Field Guides - Atlantic Coast Fishes*. Houghton Mifflin Company, Boston. 1986.



COLORS & PATTERNS OF ESTUARINE ANIMALS IN THE NEWARK BAY COMPLEX

Discovery Sheet #17

Name: _____ Date: _____

ANIMAL'S NAME:

Complete the following using reference materials in the library, on the Internet, or from books in your classroom.

1. Describe the animal's habitat:
2. Draw and describe the animal's life cycle:
3. Describe the animal's colors and patterns:
4. Give reasons why you think the animal is colored or patterned the way it is.

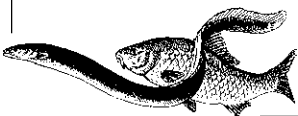


Figure 11B
FLOUNDER

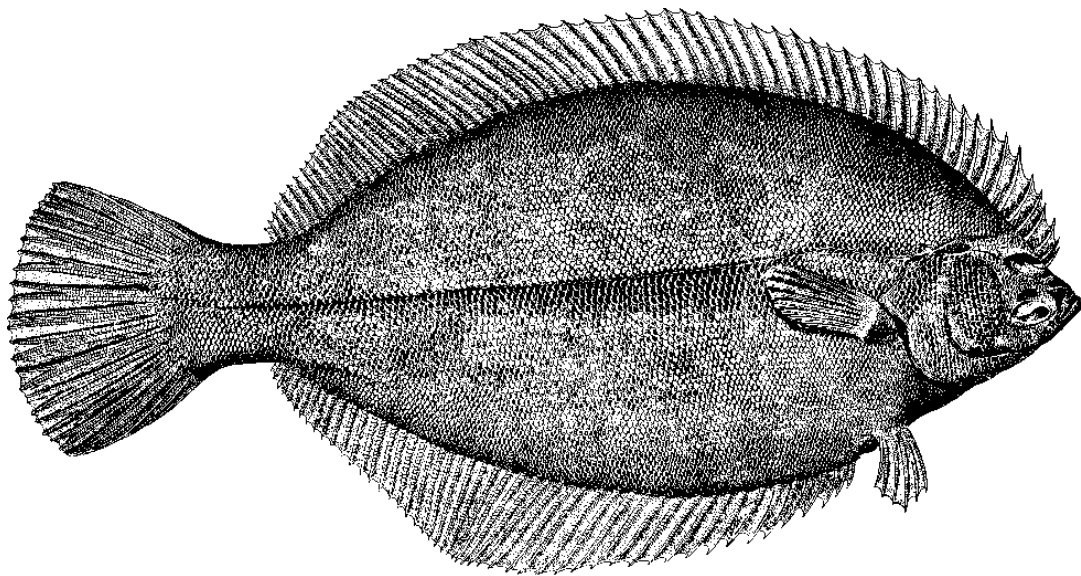


Figure 11C
STRIPED BASS

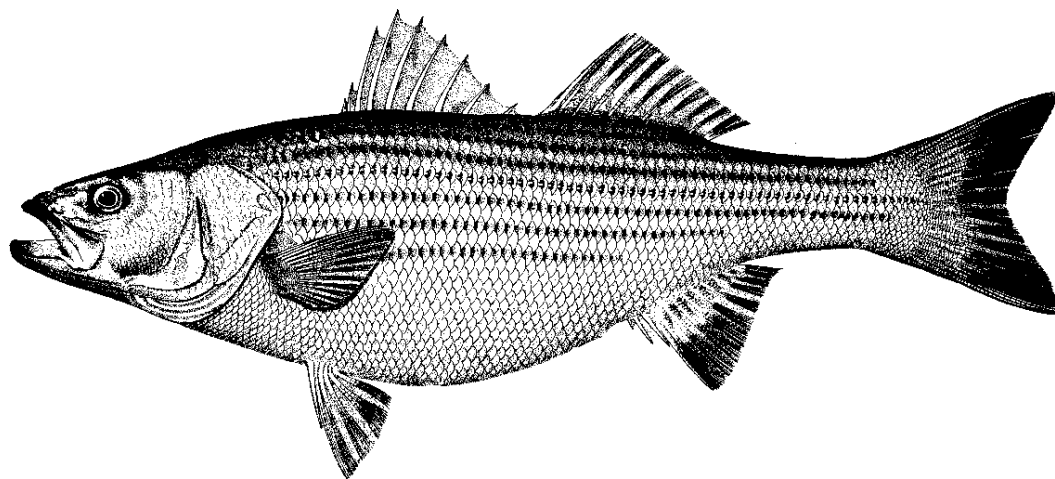


Figure 11D
BLUE CRAB

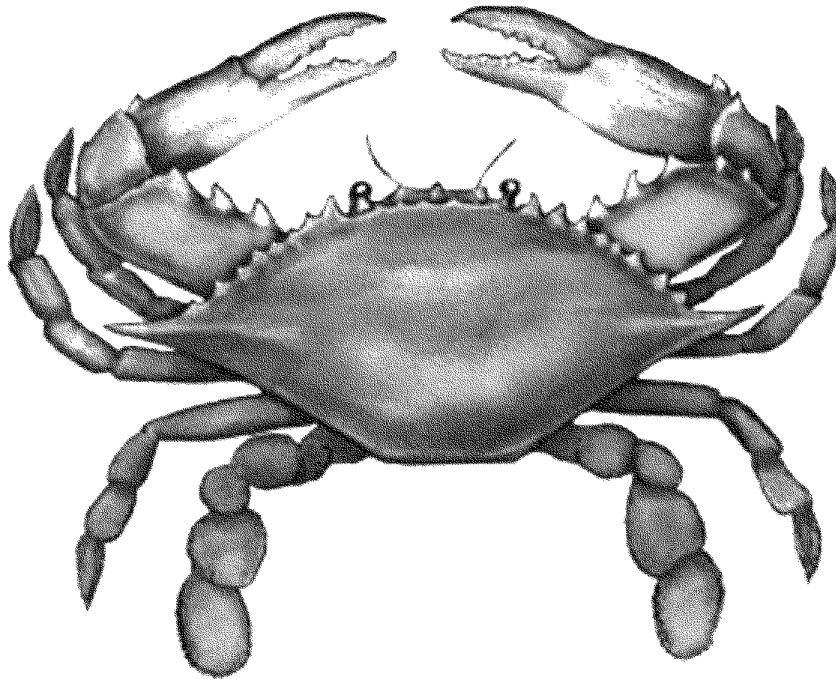


Figure 11E
KILLIFISH

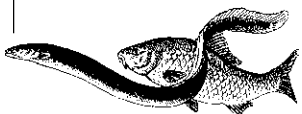
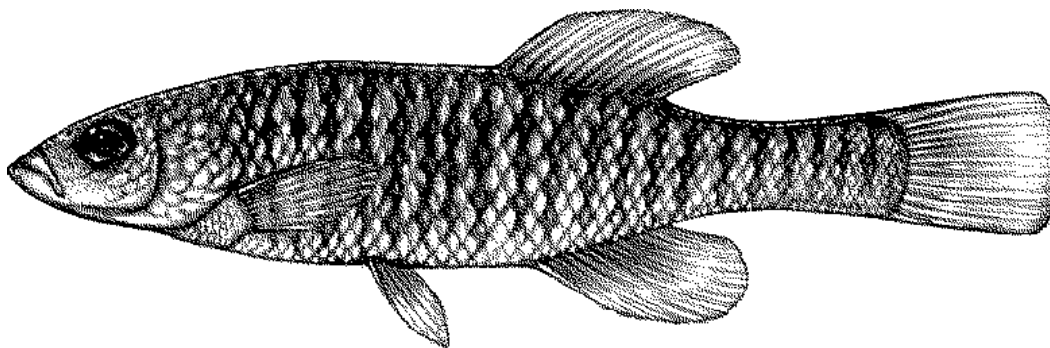


Figure 11F
WHITE PERCH

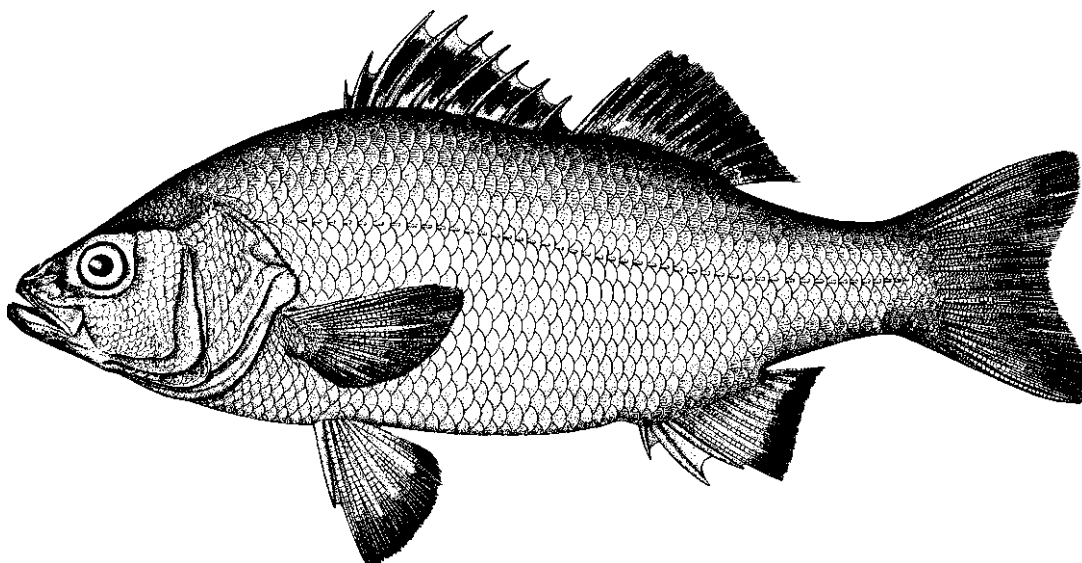


Figure 11G
BLUEFISH

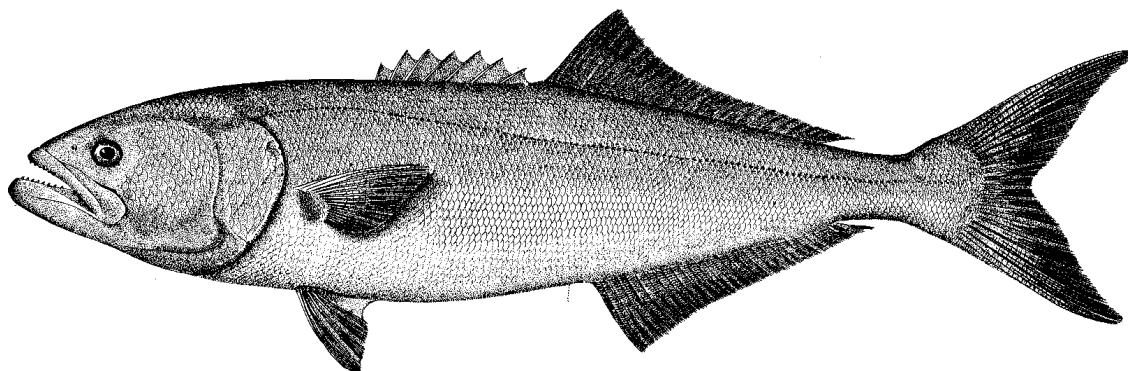


Figure 11H
WEAKFISH

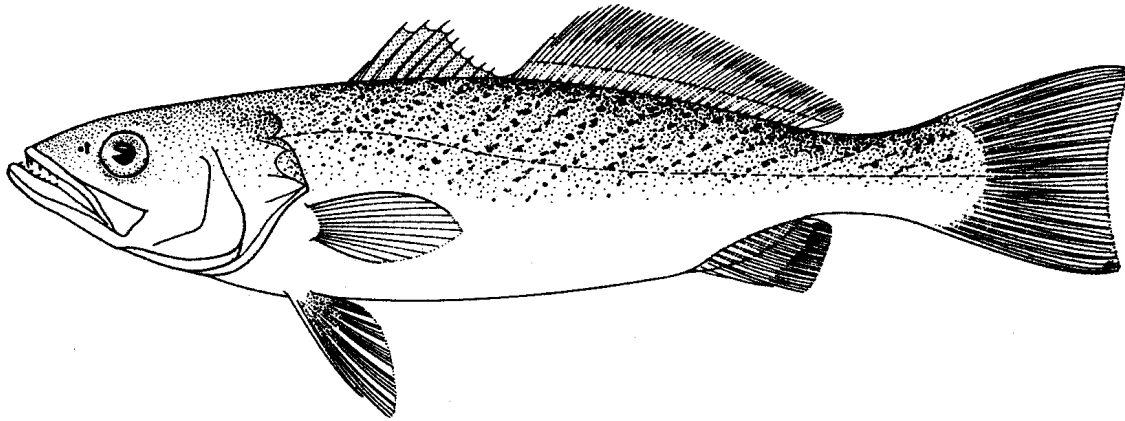
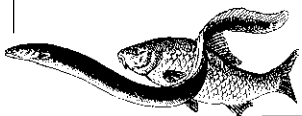
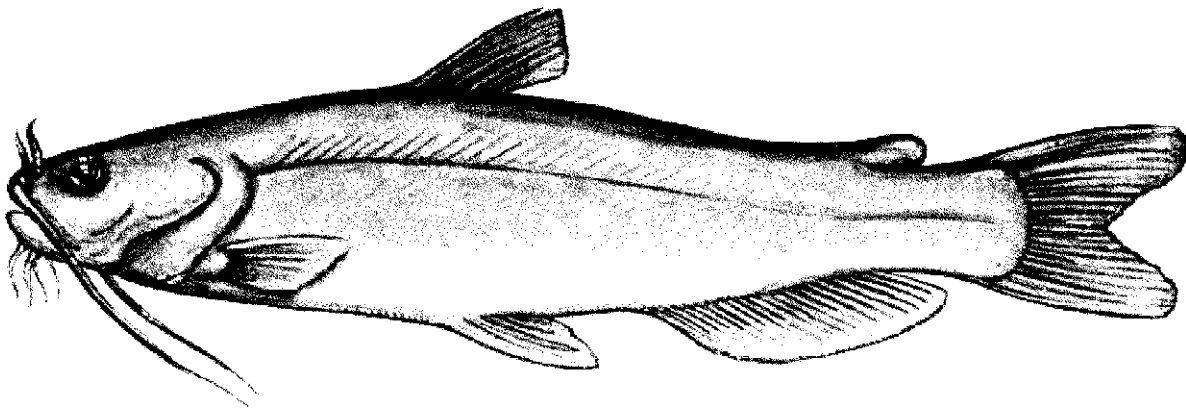
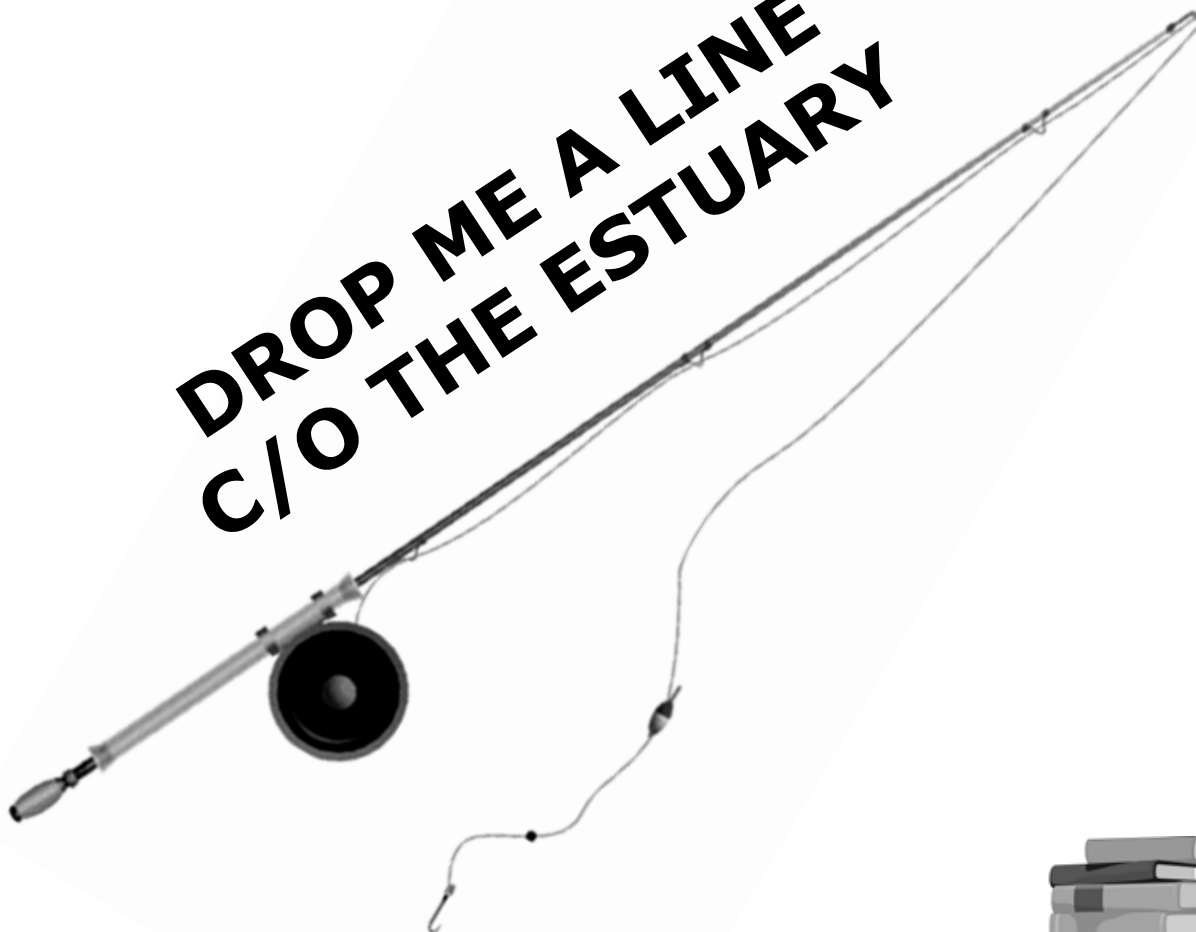


Figure 11I
WHITE CATFISH



DROP ME A LINE C/O THE ESTUARY



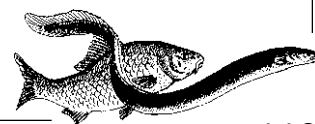
BACKGROUND INFORMATION



Recreational fishing has been documented back to medieval times. It differs from subsistence fishing and commercial fishing in that it is done primarily as a hobby and pastime activity. In recent years, recreational fishing has evolved into an extremely popular hobby upon which anglers spend billions of dollars annually.

In support of this sport/hobby, anglers buy equipment, boats, motors, clothing, books, videos and bait; they hire guides and pay for fees and licenses; they buy food, stay in motels, and pay for all the associated travel expenses for fishing trips.

Each angler has his or her preferred method of catching fish, and the choice of equipment depends on the species of fish sought. Equipment and fishing techniques can vary from simply standing on the side of a water body with a handline, hook and bait, to chartering expensive boats and using specialty rods. Many recreational anglers opt to employ a catch and release technique that allows them to continue enjoying the thrill of the sport, while ensuring that the fish are returned to their environment. See "Catch and Release Fishing", page 162.



LEVEL

Grades 4 to 8

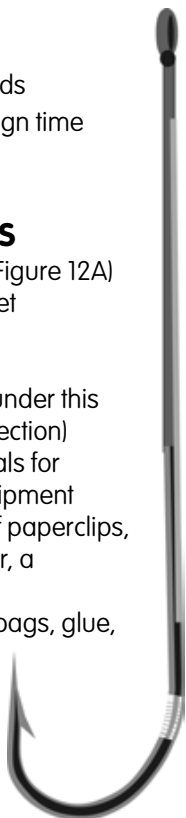
LENGTH

3 class periods
research and design time



MATERIALS

- o Species Fact sheet (Figure 12A)
- o Equipment Fact sheet (Figure 12B)
- o resource materials (suggestions listed under this lesson's reference section)
- o variety of art materials for creating fishing equipment (ball of string, box of paperclips, pipe cleaners, paper, a selection of dowels, cheesecloth, onion bags, glue, tape, etc.)



OVERVIEW

People have invented and have used many different devices for catching fish and other aquatic animals.

OBJECTIVES

Students will:



Identify food preferences for specific aquatic species;



Devise methods and equipment for catching a specific aquatic animal;



Assess and evaluate invented fishing equipment for safety and practicality;



Discuss different motives that anglers have for catching fish.



ADVISORY LINK

There is heavy use of the Newark Bay Complex by recreational anglers. The Fish Consumption Advisories act as guidelines to promote the safe consumption of various species that may be affected by contaminants in the estuary. According to the Advisories, some species should not be consumed at all. However, anglers can still enjoy fishing by participating in "catch and release," a strategy that returns the animal to its environment.

KEYWORDS

angling
catch and release
commercial fishing
recreational fishing
subsistence fishing

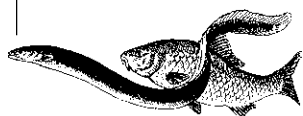
STUDENT PREREQUISITES

An understanding of the aquatic food chain
General knowledge of the estuary's habitats

PROCESS SKILLS

communicating
measuring
categorizing
comparing and contrasting

interpreting data
analyzing
synthesizing
evaluating



PLANNING



1. Write the names of the animals (from Figure 12A) on the board or a separate sheet of large paper for display. (Note: The additional information on the sheet is for teacher use, not to distribute to the students.)
2. Duplicate one Equipment Fact sheet (Figure 12B) for each student.
3. Amass art materials.
4. Make arrangements to have an angler come to the class to give a short talk on local fish.

PROCEDURE SETTING THE STAGE

Poll the class to discover how many students have gone fishing or have seen people fish. Ask the students to describe what they saw, the place where they fished, what they caught, the equipment they used, and the bait they used.

THE ACTION

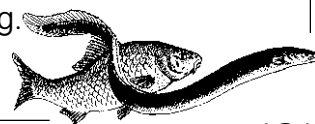


Period 1

1. Say to the students, "In the forest we see animals find food at different layers – some will find it on the ground, others on plants, and still others in the trees." Describe the layers in an aquatic habitat. What types of food are there for aquatic animals to eat? [*lotter fish, worms, insect larvae, detritus, vegetation, crustaceans*]. Where might the animals find this food? [*on the surface, among the rocks, in the mud, at different depths*]
2. Ask students to describe the kinds of food given to a variety of domestic pets. Discuss why we feed different pets different types of food. [*Each animal is attracted by different food.*]
3. If animals on land have different food preferences, what do you think about aquatic animals? Ask the students to describe types of fish bait and how they know which bait catches which fish. [*from experience, books, videos, talking to anglers, etc.*]
4. Have pairs of students select a species from the list (from Figure 12A).
5. Tell the students to use independent research time (at home, in the library, etc.) to find out about their animals' habits, habitat and food preferences. If possible, invite an angler to the classroom to help the children with this portion of the activity.

Period 2

1. Discuss the difference between catching an animal out of need (includes subsistence fishing and commercial fishing) and catching one for sport. Describe the terms subsistence fishing, recreational fishing and commercial fishing. Discuss the needs being met by each practice (Subsistence – feed self and family, Recreational – relaxation, testing skill, enjoyment, Commercial – to earn a living).
2. Ask the students, "Which of the three types of anglers needs to keep the fish? [*subsistence and commercial*]. If the angler doesn't have to keep the fish for food, what other options does he or she have to do with it? [*Mount the fish for trophy, return it to the water, or share it with other people.*]. Introduce the phrase "catch and release." Discuss the advantages and disadvantages of this technique of fishing. (See page 162.)



3. Using the materials provided, ask each pair of students to devise a method and equipment to catch the animal they have researched. Note that their design should take into consideration the following attributes: type of food the animal prefers and what that food item looks like, habitat in which one would find the animal (e.g. deep water vs. shallow marsh), whether the method focuses on bait or lures, what particular safety features should be in place on the equipment. Also note that each pair will be expected to share the method and equipment with the rest of the class.
4. Tell the students that their presentation will be critiqued on the following items:
 - The equipment and method – feasibility, ease of design, creativity, safety.
 - The presentation – clarity, degree of involvement by participants, use of visuals, ability to answer questions posed by the audience.

Period 3

Have each pair of students demonstrate their fishing equipment and method. Share with students the Equipment Fact Sheet (Figure 12B) for them to compare their method/equipment to what is already being used.

ASSESSMENT STRATEGIES

Have the students:

- ☐ Redesign their equipment based on their observations and class discussion about other types of equipment and safety.

STAYING INVOLVED



Generate a list of local sites for fishing as well as bait and tackle shops and places to obtain licenses. Plot these (and the extent of the advisories) on a map of the town or county. Have the students research how to get there and what restrictions might apply before fishing any of these sites.

EXTENSIONS



Write about a fishing experience or make up a story about “the one that got away.”



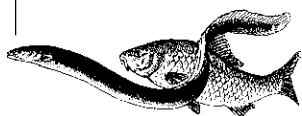
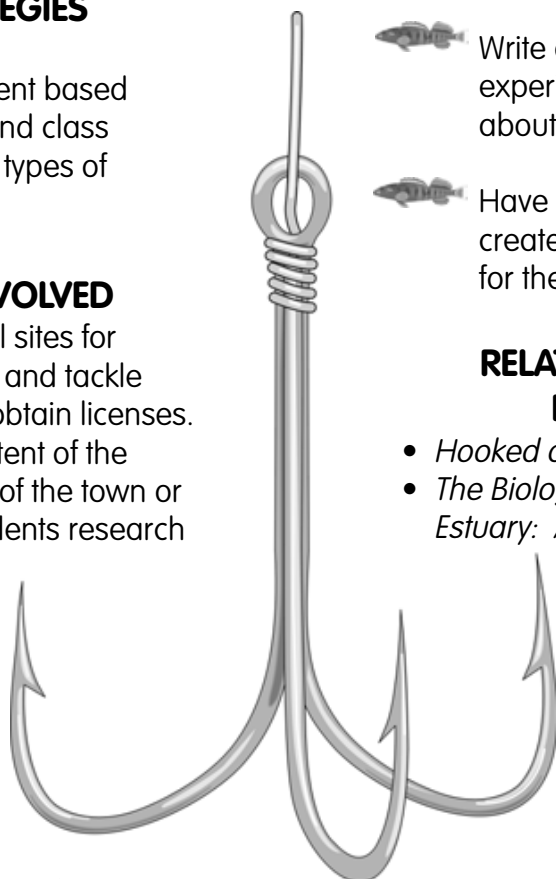
Have each pair of students create a sales advertisement for the equipment.

RELATED EDUCATION RESOURCES

- *Hooked on Fishing - Not on Drugs*
- *The Biology of the Hudson-Raritan Estuary: A Teacher's Guide*

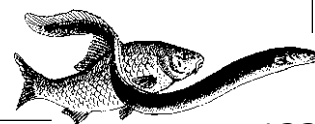
REFERENCE

- AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.
- McClane, A.J. *McClane's Field Guide to Saltwater Fish of North America*. Henry Holt and Company, New York. 1974.
- New Jersey Marine Sciences Consortium. *The Hook Book: A Guide to Common Marine Organisms of Sandy Hook*. Sandy Hook, NJ. 1987.



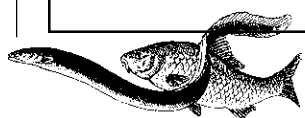
SPECIES FACT SHEET

SPECIES	WHERE CAUGHT	HOW CAUGHT	BAIT
BLUE CRAB	Tidal Creeks and Bays	Handline, Scoop Net, Various Traps	Fish Chicken Chunks
BLUEFISH	Inlets, Bays, Surf, Ocean	Trolling, Jigging, Casting, Fly Fishing	Lures, Crabs, Bait Fish, Artificial Flies
STRIPED BASS	Bays, Rivers, Surf, Ocean	Trolling, Casting, Fly Fishing	Lures, Crabs, Squid, Herring, Eel, Artificial Flies
WHITE PERCH	Bays, Brackish Rivers	Trolling, Casting, Fly Fishing	Minnows, Grass Shrimp, Spinnerflies, Lures
AMERICAN EEL	Bays, Brackish Rivers	Bottom Fishing	Most Baits - Crabs, Squid, Minnows, Grass Shrimp
WHITE CATFISH	Rivers, Streams, Lakes, Brackish Backwaters	Bottom Fishing	Worms, Minnows, Crayfish
WINTER FLOUNDER	Mud Flats in Bays	Still Fishing or Drift Fishing	Sea Worms, Clams, Mussels
BLACKFISH /TAUTOG	Among Rocks, Vegetation, Wrecks	Still Fishing	Crabs, Mussels, Bloodworms, Clams



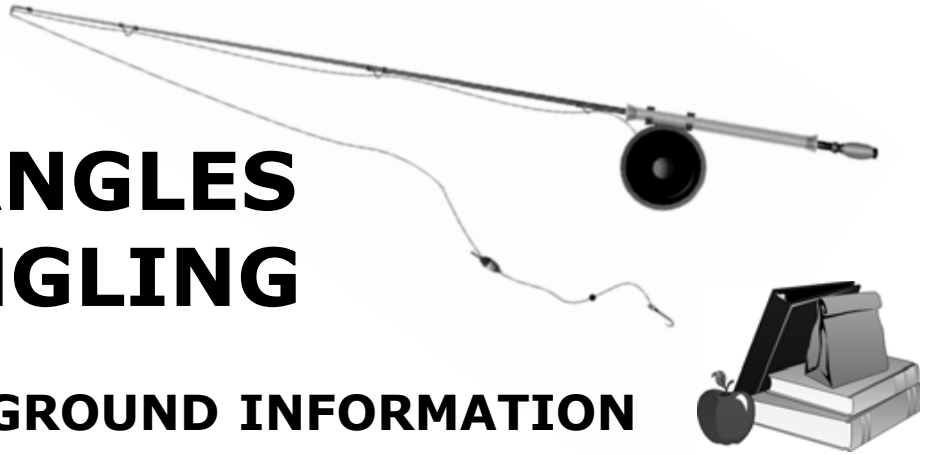
EQUIPMENT FACT SHEET

METHOD	EQUIPMENT	LOCATION	TECHNIQUE
STILL FISHING	Hand Line, Rod and Reel, Weighted Line	Fishing from a fixed site like the shoreline, a pier, a bridge, or an anchored boat	Keep bait still in the water or resting on the bottom until the fish bites
DRIFT FISHING	Weighted or Unweighted Line	Fish from a drifting boat	Trail the line behind a slow-moving boat
JIGGING	Line with a lure called a jig	Fish from a fixed site like a boat, a pier, or from the shoreline	Move the line up and down with a jerking motion
NETS	Scoop Net, Long Handled Net	Fish from the shoreline or from a boat	Scoop or skim the bottom with a net
TRAPS	Trap	Fish from a bridge or from a boat	Lower a trap with bait into the water and wait
TROLLING	Live Bait or Lure	Fish from behind a moving boat or from a bridge or pier	Tow a baited line
FLY FISHING	Fly Rod and Reel	Fish from the shoreline, a pier, a bridge, or a boat	Cast a "fly" on a line
SURF CASTING	Rod and Reel	Fish from the shoreline in the ocean's surf	Cast a baited line into the surf



THE ANGLES OF ANGLING

BACKGROUND INFORMATION



The sport of fishing has evolved over the years to reflect countless methods and equipment for catching fish. There are ample opportunities and sophisticated equipment for anglers to pursue their sport, but they must adhere to the restrictions that apply to many species.

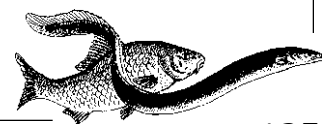
Fishery managers, such as federal and state fish and wildlife agencies, establish size limits, number limitations (bag limits) and seasonal closures. They also are involved in studying the health of the aquatic environment and how it reflects on the safe consumption of certain species. It is important that anglers are familiar with both the regulations about keeping fish as well as the guidelines on consuming fish or crabs that may contain concentrated levels of contaminants.

Size and bag limits are used to protect the spawning populations of a particular species. Size limits designate standards for keeping fish of a certain length or weight, whereas bag limits apply to the number of individual fish of a given species an angler may take at a given time. Other management tools include establishing seasons during which species can be taken and dictating the type and size of the fishing tackle permitted. These types of management strategies relieve pressure on

the animal species during a particular part of the year. During spawning season, when animals are under environmental and biological stress (such as cold water making a species sluggish and easier to catch), or when the estimated number of a species is in short supply, the population of the species needs to be protected.

Health advisories, like the ones outlined in "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters" (Appendix A) were developed for species that accumulate contaminants from the environment into their fatty tissue. These guidelines suggest ways to minimize a person's exposure to potentially harmful contaminants like dioxins, PCBs, chlordane and mercury. They also recommend a maximum number of individual animals of a species that can be consumed by a person during a given time period, and include details on proper cleaning, skinning and trimming before consumption.

All of these restrictions are based on the assumption that the angler will catch and keep a particular fish. Many anglers adhere to the "catch and release" technique, which promotes the sport of fishing, but returns the fish to its habitat.



LEVEL

4 to 6

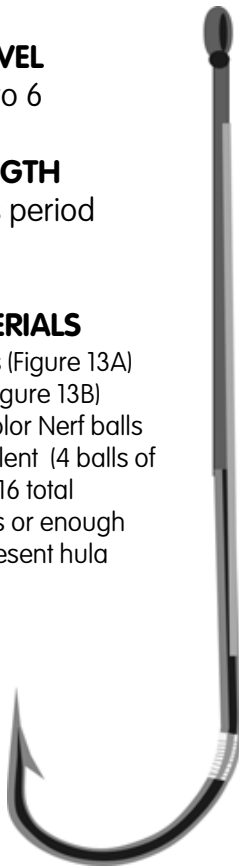
LENGTH

1 class period



MATERIALS

- o Angler cards (Figure 13A)
- o Fish cards (Figure 13B)
- o 4 different color Nerf balls or the equivalent (4 balls of each color) - 16 total
- o 4 hula hoops or enough string to represent hula hoop size



OVERVIEW

Students learn that fishing practices and methods are regulated for human health and conservation of resources.

OBJECTIVES

Students will:



Describe various methods of angling and the type of fish caught by each;



Explain the guidelines and restrictions that apply to catching fish and why they are in effect.



ADVISORY LINK

Fish and other aquatic animals that live in the waters of the Newark Bay Complex are caught using a variety of methods and according to specific regulations imposed by state and federal wildlife agencies. There are additional guidelines in place for the species listed in the Fish Consumption Advisories to warn anglers of the presence of possible cancer-causing contaminants in these animals' fatty tissue.

KEYWORDS

angler

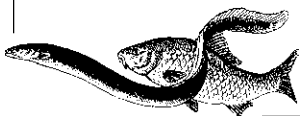
Fish Consumption Advisories

STUDENT PREREQUISITES

Basic knowledge of fishing methods

PROCESS SKILLS

communicating
analyzing
observing
formulating hypotheses
interpreting data



PLANNING



1. Make 1 copy each of Figures 13A and 13B.
2. Cut, mount and laminate the cards.
3. Obtain the Nerf balls (or an equivalent)
4. and the hula hoops (string, cones, etc.) that will designate "pails."
Set up the playing field as in Figure 13C.

PROCEDURE SETTING THE STAGE

Ask the students to describe what types of fishing (angling) they have heard about, seen people do, or have done themselves. Discuss why certain methods may be preferred over others.

THE ACTION

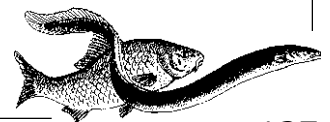


Period 1

1. Select four students to represent the anglers. Give each an angling card and four of the same color Nerf balls.
2. Distribute a fish card (Figure 13B) to each remaining student.
3. Explain that the information on the fish card tells what method of angling can be used to catch the fish, in what season the animal can be caught and any other restrictions that are placed on the species. Note: Fishing restrictions reflect those for children and high-risk individuals.
4. Explain the rules:
 - a. Students with fish cards must move around within the boundaries of the playing field (*water of the Newark Bay Complex*).
 - b. Anglers try to "catch" a fish by tossing the Nerf ball at a student holding a fish card. When a student is tagged, he/she must go to that angler and read the card with the angler to determine if the angler's method can catch the fish. If yes, the student must stand inside the area designated as the "pail." If not, the student goes back onto the field to continue play.
 - c. When anglers have used up their four Nerf balls (regardless of whether they have caught a fish or not) they must sit down in their spot.
 - d. Play the first round until all anglers are sitting down.
5. Continue the play by allowing the students to switch roles.

CLOSING DISCUSSION

1. What types of fish did each angling method catch?
2. Which fish were left in the water? Why? [*size restrictions, location restrictions, luck, good maneuvering*]
3. What would happen if the number of anglers was increased? [*anglers may not catch any fish because of competition or restrictions, more fish might be taken*]
4. What types of restrictions did the anglers encounter? [*seasonal, number of fish allowed, length of fish, weight of fish, health restrictions*] Discuss how these reflect real restrictions.
5. Why do you think regulations were developed to restrict catching certain species? [*to keep a species from being fished out, to keep a population stable enough for successful reproduction, to minimize the amounts of toxins that one person can ingest*]



ASSESSMENT STRATEGIES

Have the students:

- ❑ Describe their strategies as anglers (for catching fish) or as fish (from being caught by an angler).
- ❑ Have the students create a written version of what happened to them during the game.

STAYING INVOLVED



Interview an angler that uses one or more of the methods from the game and report back to the class about how it is done.



Accompany an angler to learn how to fish.

EXTENSIONS



Have the students redesign the game to include a "catch-and-release" component.



Have students research different species and introduce more types of fish into the game.



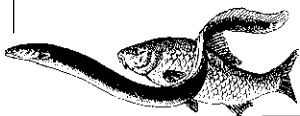
Play the game to reflect some "high risk" anglers as explained in the Fish Consumption Advisories (see Appendix A, page 169).

RELATED EDUCATION RESOURCES

- *Hooked on Fishing - Not on Drugs*
- *Future Fisherman Foundation. Aquatic Resources Education Curriculum.*

REFERENCE

- AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.
- New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Marine Fisheries Administration. "Salt Water Fishing in New Jersey."
- _____. "Marine Recreational Fishing Seasons, Possession & Minimum Size Limits." 1996.
- New Jersey Department of Environmental Protection, Division of Science, Research and Technology. "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters." 2004 edition. (Appendix A)
- McClane, A.J. *McClane's Field Guide to Saltwater Fish of North America*, Henry Holt and Company, New York. 1974.
- New Jersey Marine Sciences Consortium. *The Hook Book: A Guide to Common Marine Organisms of Sandy Hook*, Sandy Hook, NJ. 1987.



ANGLER CARDS

Angler 1 (A1)

Hook and Line
DEEP WATER in a Bay, Inlet or Offshore
From a Boat

Angler 2 (A2)

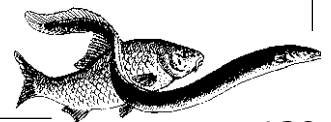
Hook and Line
SHALLOW WATER
From a Boat, Fishing Pier or From the Edge

Angler 3 (A3)

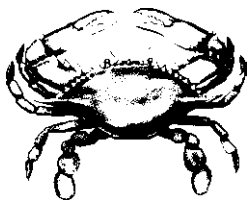
TRAP or NET
From a Bridge or Fishing Pier

Angler 4 (A4)

Hook and Line
SURF CASTING
From the Shoreline



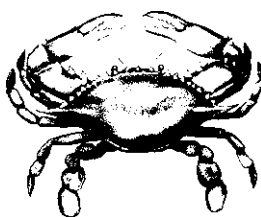
FISH CARDS

BLUE CRAB (Adult)

Angler's Method - Hook and line in shallow water

Season - March 15 through November

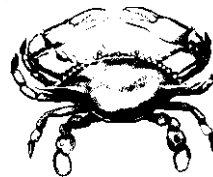
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUE CRAB (Adult)

Angler's Method - Trap

Season - March 15 through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUE CRAB (Shedder - soft shell)

Angler's Method - Net

Season - March 15 through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUEFISH (5 pounds)

Angler's Method - Hook and line in deep water

Season - May through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUEFISH (8 pounds)

Angler's Method - Surf casting

Season - May through November

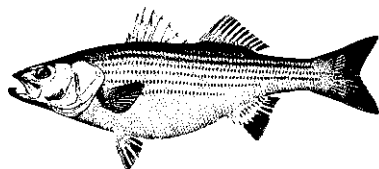
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

BLUEFISH (15 pounds)

Angler's Method - Hook and line from the surf

Season - May through November

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

STRIPED BASS (36 inches)

Angler's Method - Hook and line from the surf

Season - March through December

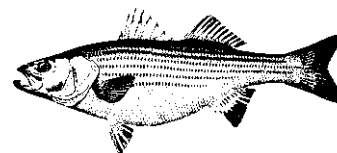
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

STRIPED BASS (18 inches)

Angler's Method - Hook and line in shallow water

Season - March through December

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

STRIPED BASS (30 inches)

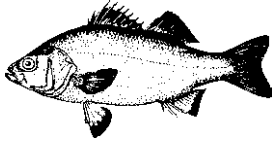
Angler's Method - Hook and line in shallow water

Season - March through December

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.



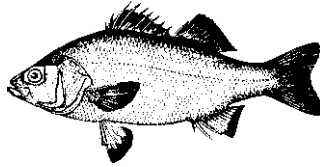
FISH CARDS

WHITE PERCH (1 pound)

Angler's Method - Hook and line in shallow water

Season - All Year

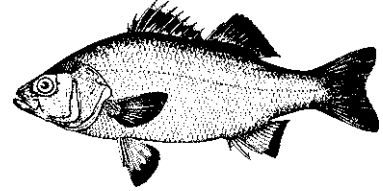
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE PERCH (½ pound)

Angler's Method - Hook and line in shallow water

Season - All Year

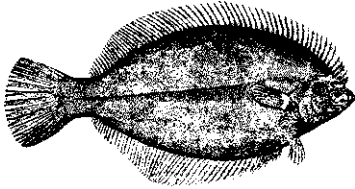
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE PERCH (2½ pounds)

Angler's Method - Hook and line in shallow water

Season - All Year

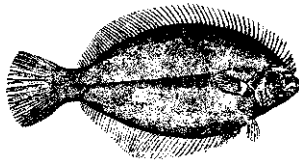
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WINTER FLOUNDER (13 inches)

Angler's Method - Hook and line in shallow water

Season - March through May; September 15 through December

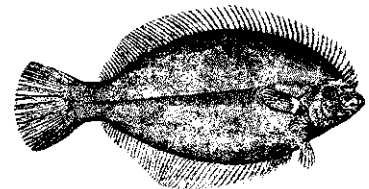
Restrictions - Must be more than 11 inches long to keep.

WINTER FLOUNDER (9 inches)

Angler's Method - Net

Season - March through May; September 15 through December

Restrictions - Must be more than 11 inches long to keep.

WINTER FLOUNDER (12 inches)

Angler's Method - Hook and line in shallow water

Season - March through May; September 15 through December

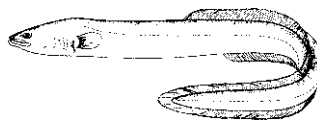
Restrictions - Must be more than 11 inches long to keep.

AMERICAN EEL (14 inches)

Angler's Method - Trap

Season - April through October

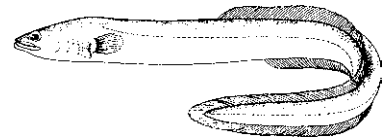
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

AMERICAN EEL (20 inches)

Angler's Method - Net

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

AMERICAN EEL (28 inches)

Angler's Method - Trap

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.



FISH CARDS

WHITE CATFISH (3 pounds)

Angler's Method - Hook and line in shallow water

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE CATFISH (4 pounds)

Angler's Method - Hook and line in shallow water

Season - April through October

Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WHITE CATFISH (1 pound)

Angler's Method - Net

Season - April through October

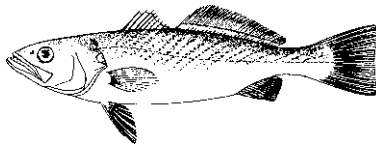
Restrictions - Listed in the Fish Consumption Advisories. Should not be taken or eaten from the Newark Bay Complex.

WEAKFISH (10 inches)

Angler's Method - Hook and line in the surf

Season - All Year

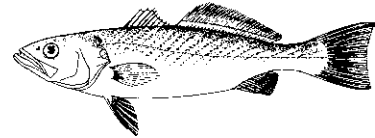
Restrictions - Must be at least 13 inches long to keep.

WEAKFISH (16 inches)

Angler's Method - Hook and line in shallow water

Season - All Year

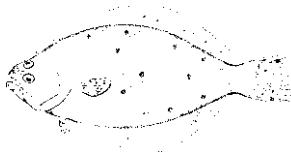
Restrictions - Must be at least 13 inches long to keep.

WEAKFISH (15 inches)

Angler's Method - Hook and line in deep water

Season - All Year

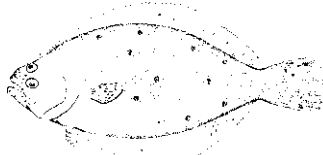
Restrictions - Must be at least 13 inches long to keep.

FLUKE (Summer Flounder) (12 inches)

Angler's Method - Hook and line in shallow water

Season - May through Mid-October

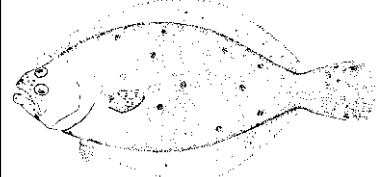
Restrictions - Must be at least 16½ inches long to keep.

FLUKE (Summer Flounder) (17 inches)

Angler's Method - Hook and line in the surf

Season - May through Mid-October

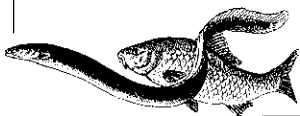
Restrictions - Must be at least 16½ inches long to keep.

FLUKE (Summer Flounder) (20 inches)

Angler's Method - Hook and line in deep water

Season - May through Mid-October

Restrictions - Must be at least 16½ inches long to keep.



FISH CARDS

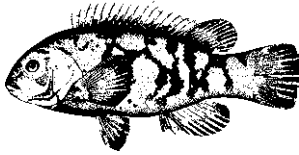
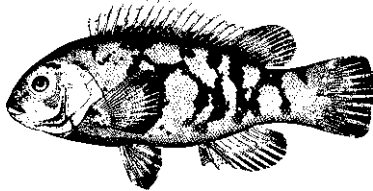
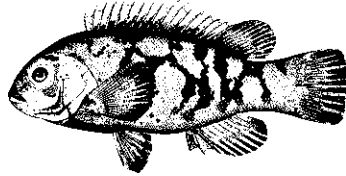
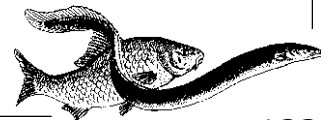
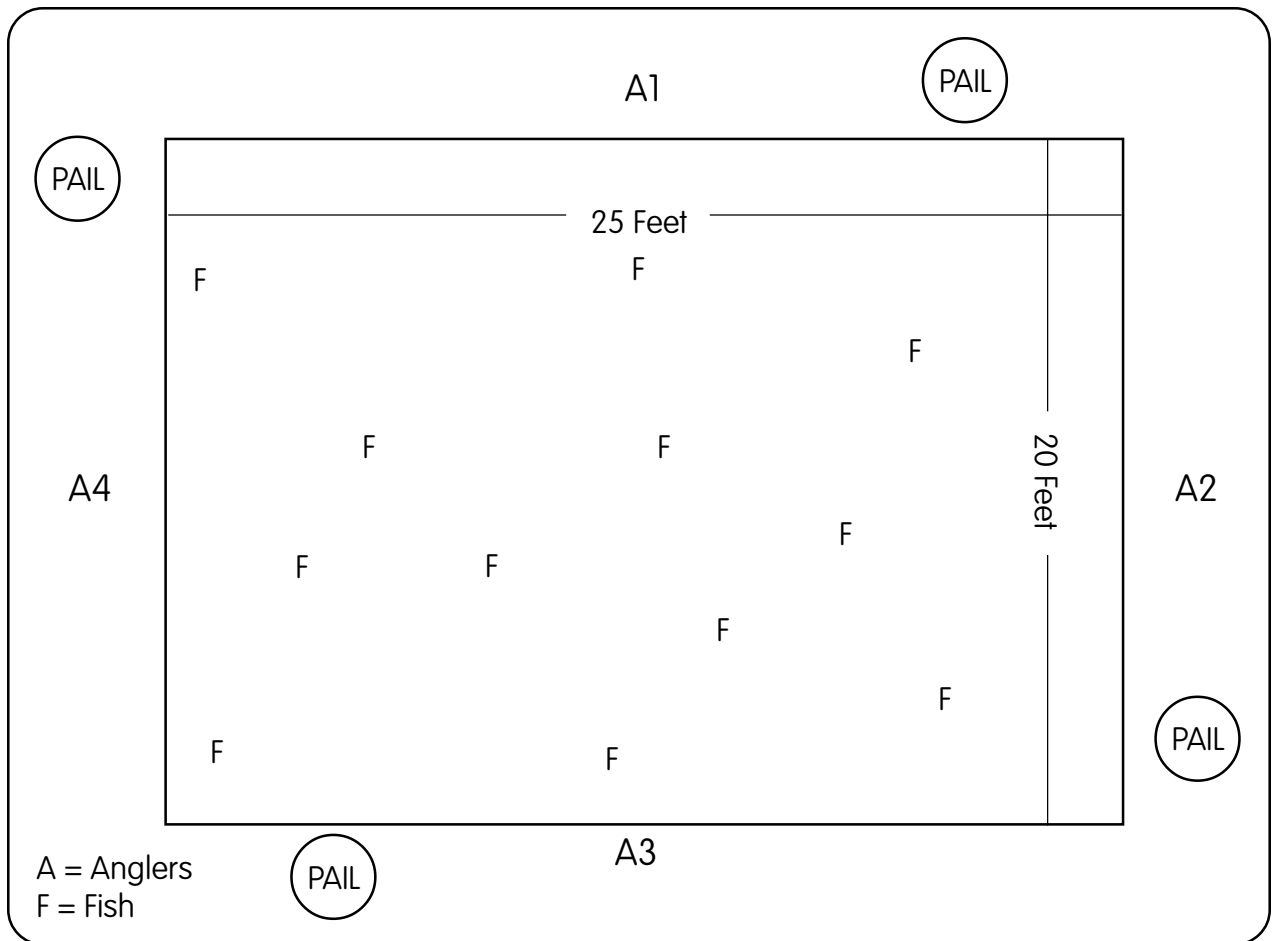
<p>TAUTOG (Blackfish) (10 inches)</p>  <p><u>Angler's Method</u> - Hook and line in shallow water <u>Season</u> - All year Restrictions - Must be at least 14 inches long to keep.</p>	<p>TAUTOG (Blackfish) (18 inches)</p>  <p><u>Angler's Method</u> - Hook and line in the surf <u>Season</u> - All year Restrictions - Must be at least 14 inches long to keep.</p>	<p>TAUTOG (Blackfish) (15 inches)</p>  <p><u>Angler's Method</u> - Hook and line in deep water <u>Season</u> - All year Restrictions - Must be at least 14 inches long to keep.</p>
---	---	--

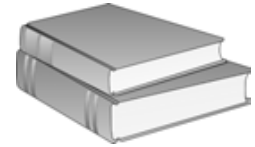
Figure 13C

SET-UP FOR THE PLAYING FIELD



COMINGS AND GOINGS

BACKGROUND INFORMATION

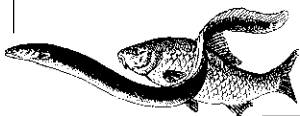


The estuary ecosystem is often described as an aquatic nursery. Many species of fish and other aquatic animals spawn in the shallow, nutrient-rich waters, and young animals spend their first few months or years feeding in these relatively safe environments. These species, along with others, may also be migratory – coming to the Newark Bay Complex during certain seasons.

Some fish respond to the changing ocean temperature by moving from cooler to warmer water or from warmer to cooler water. When schools of prey fish travel up and down the Atlantic coast, predatory fish (and anglers) follow. New Jersey is well known for the seasonal occurrence of bluefish when large numbers migrate offshore in late April and early May. Migration occurs also when it is time for fish to spawn. American eels spend most of their lives in freshwater, but return to the sea to spawn. On the other hand, striped bass and other anadromous fish such as river herring and American shad do the opposite. They spend most of their lives in the ocean and ascend freshwater streams to spawn.

Like most other animal populations, fish populations are under pressure from human interactions. Water pollution, habitat degradation and encroachment all contribute to the decline in numbers and size of fish. Additionally, some anglers pursue their hobby with such tenacity that they will go to extreme lengths to fish in even the most remote areas. Those studying fish behavior have indicated that some species of fish have changed their feeding and migrating patterns to avoid areas that are heavily fished.

Continued observation and research enables fishery managers to keep track of the numbers and types of fish taken from the fishery, both commercially and through sport fishing. Management practices take into consideration the migratory patterns of species, their life cycles, and the spawning season to ensure that the fishing industry and the sport do not negatively impact an individual species' population. They also ensure that these fish will be available for recreation and commercial use in the future.



LEVEL

4 to 8

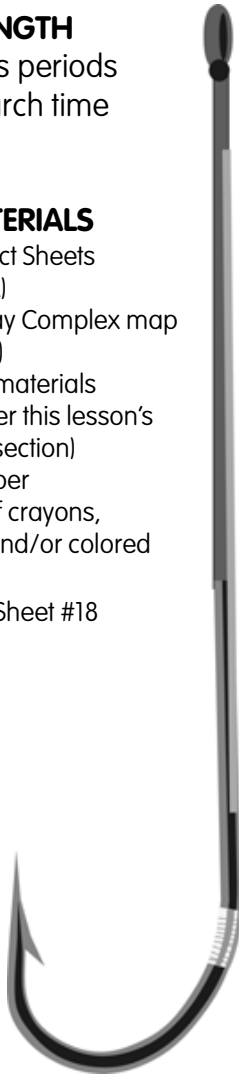
LENGTH

2 class periods
research time



MATERIALS

- o Species Fact Sheets (Figure 14A)
- o Newark Bay Complex map (Figure 5A)
- o reference materials (listed under this lesson's reference section)
- o writing paper
- o a variety of crayons, markers, and/or colored pencils
- o Discovery Sheet #18



OVERVIEW

Seasonal changes, as well as environmental and human pressures, may affect aquatic animals during their life spans.

OBJECTIVES

Students will:



Describe the life cycle and seasonal movement patterns of an aquatic animal;



Describe how natural and human-made pressures affect these animals;



Explain how the seasonal movements of aquatic animals may affect the accumulation of contaminants in their bodies.



ADVISORY LINK

The fish and crabs listed in the Fish Consumption Advisories spend all or part of their life in the estuary waters of the Newark Bay Complex. Since scientists have determined that sediments in the Newark Bay Complex contain unsafe levels of dioxins and PCBs, these species are more likely to accumulate contaminants because of their seasonal movements, spawning habits and feeding habits.

KEYWORDS

anadromous
bioaccumulation
catadromous

contaminants
estuary
spawn

fishery
migration

STUDENT PREREQUISITES

Basic map-reading skills
General fish biology as it relates to life cycles
An understanding of migration related to aquatic species

PROCESS SKILLS

communicating
comparing
evaluating
categorizing

analyzing
interpreting data
synthesizing



PLANNING



Make copies of Figures 5A, 14A (2-sided) and Discovery Sheet #18 for each student.

PROCEDURE SETTING THE STAGE

Discuss basic human needs. Ask, "If you were cold, what would be some of the things you would do to warm yourself? What would you do if you were thirsty?" Some animals move from location to location to fulfill their basic needs. Discuss migration.

THE ACTION



Period 1

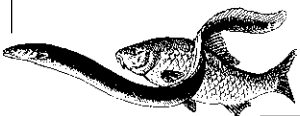
1. Distribute a copy of the Newark Bay Complex map (Figure 5A) to each student. Discuss or review the difference between fresh water, brackish water, and salt water. Determine where these might be found on the map.
2. Instruct the students to color-code the types of water (i.e. salt water, brackish water, fresh water). Refer the students to Figure 5B (Tidal Marshes in and Near the Newark Bay Complex) to estimate the extent of each type of water.
3. Distribute Figure 14A, Discovery Sheet #18 and a copy of the Fish Consumption Advisories (Appendix A) to each pair of students. Have each pair select a species and complete the research using the Fish Fact sheets or other research material as needed.

Period 2

Have each student add his/her animal's seasonal movements and life cycle information to the Newark Bay Complex map. * Note: The students may need to create a key to explain any symbols they created to explain their animal's movements and life cycle. (Example: adult = A, juvenile = J, etc.)

CLOSING DISCUSSION

1. List some of the reasons why these animals migrate [*to get food, to breed, to find warmer or cooler water*].
2. Which animals migrate from fresh to salt water (catadromous)? Which animals move from salt water to fresh water (anadromous)?
3. Which animals remain in the estuary ecosystem throughout their life?
4. Which animals eat plants or plant material? Which animals eat other animals? Which animals eat both?
5. What pressures could the animals encounter that are human-induced? What natural phenomena could affect the animals?
6. How might an animal's position in the food chain affect the long-term health of that particular animal? [*An animal at the top of the food chain has more opportunity to accumulate toxins in its fatty tissue since these contaminants increase (bioaccumulate) at each level of the food chain.*]
7. How might seasonal movements of fish affect the accumulation of toxins in the fish's body? [*A fish may not be contaminated if it is found in a contaminated area because it may not spend all of its life there. Conversely, a fish containing toxins can swim into a non-contaminated area and be eaten by a fish in that area.*]





ASSESSMENT STRATEGIES



Have the students:

- ❑ Write a story that tells the "imaginative" travels of their animals including any information they have learned about environmental or human-induced pressures.

EXTENSIONS

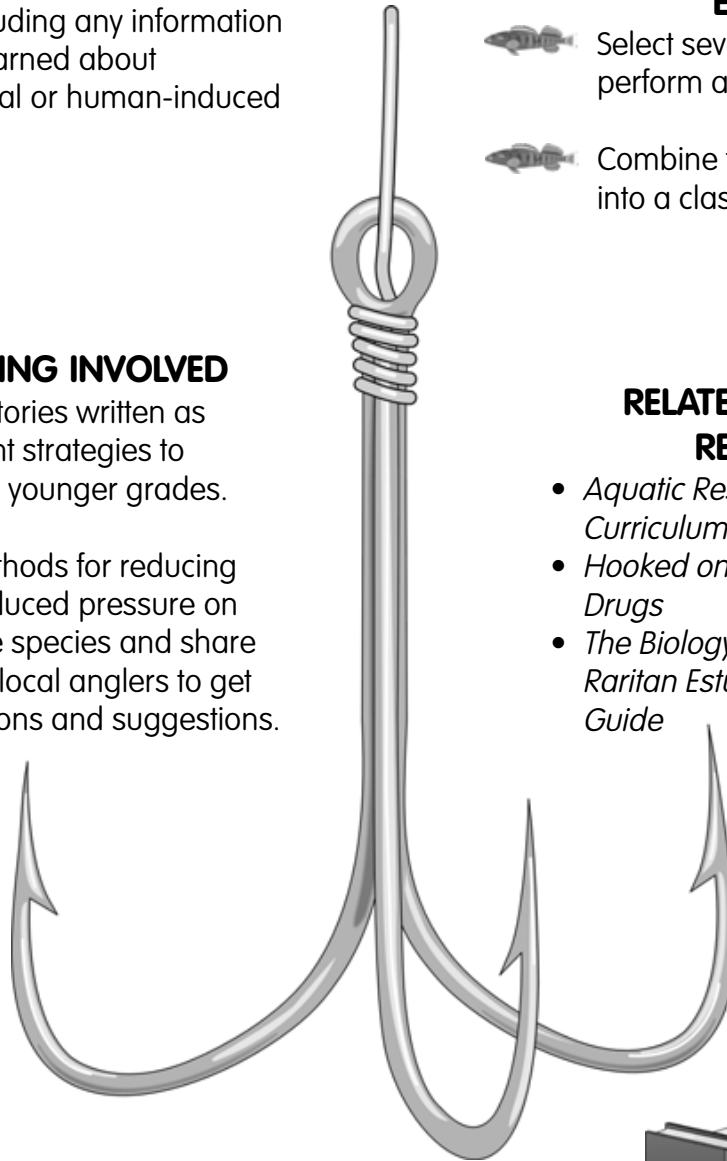
-  Select several of the stories to perform as a mini-play.
-  Combine the stories and maps into a class booklet.

STAYING INVOLVED

-  Read the stories written as assessment strategies to students in younger grades.
-  Devise methods for reducing human-induced pressure on each of the species and share these with local anglers to get their reactions and suggestions.

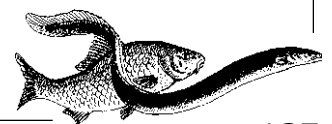
RELATED EDUCATION RESOURCES

- *Aquatic Resources Education Curriculum*
- *Hooked on Fishing - Not on Drugs*
- *The Biology of the Hudson-Raritan Estuary: A Teacher's Guide*



REFERENCE

- AFTMA (American Fishing Tackle Manufacture Association). *Pocket Guide to Fishing Inshore Salt Water*, FIM Publishing, Inc. Phoenix, MD 1990.
- New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Marine Fisheries Administration. "Salt Water Fishing in New Jersey."
- _____. "Marine Recreational Fishing Seasons, Possession & Minimum Size Limits." 1996.
- New Jersey Department of Environmental Protection, Division of Science, Research and Technology, "A Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters," 2004 edition. (Appendix A)



FISH FACTS

BLUEFISH

SEASONAL MOVEMENT: Bluefish migrate east and north along the Atlantic coast in spring and west and south in late fall.

PRESSURES: High on the food chain, popular commercial and sport fish

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Young Bluefish are called Snappers. They come into the bays and estuaries in spring and feed there all summer. All Bluefish have an impressive set of teeth because they are predators. Fishermen have found that Bluefish can see almost as well out of water as in water, so use caution when handling.

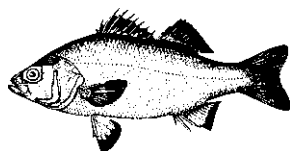
STRIPED BASS

SEASONAL MOVEMENT: Striped Bass move south in the fall to find warmer water and north in the spring. Striped Bass are anadromous, which means they move from salt water to brackish and freshwater streams to spawn in early spring.

PRESSURES: High on the food chain, popular marine game fish

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Striped Bass are predators that gorge themselves on smaller fish. As adults, their only predators are people. Also called Rockfish.

WHITE PERCH

SEASONAL MOVEMENT: White Perch usually stay in the brackish waters of estuaries and back bays, although during spawning season (April to June) perch may move further upstream into freshwater areas.

PRESSURES: Popular "pan" fish among sport fishermen

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: White Perch live in a variety of habitats because they are very adaptable.

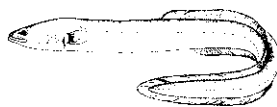
WHITE CATFISH

SEASONAL MOVEMENT: White Catfish are year-round residents with only limited seasonal movements.

PRESSURES: Catfish are bottom dwellers, which means they are closely linked to bottom sediments that contain contaminants.

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Of all the species listed in the Fish Consumption Advisories, the White Catfish is the least tolerant of salt water. Their characteristic whiskers help identify them.

AMERICAN EEL

SEASONAL MOVEMENT: Adults migrate during winter/early spring from fresh water rivers to the deep ocean to spawn.

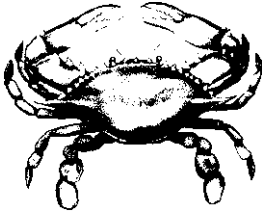
PRESSURES: Eels are bottom-dwelling omnivores that eat both live animals and dead organic material that settles into the bottom sediment.

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: As a young eel changes from a larva to an elver to an adult, it migrates back from the ocean to the freshwater rivers. Many eels are caught in traps called weirs and sent to market to be bait for other fish.



FISH FACTS

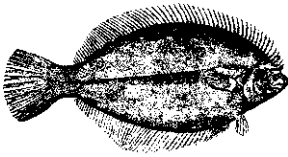
BLUE CRAB

SEASONAL MOVEMENT: Blue Crabs spend most of their life cycle in the estuary, although females move into the ocean to lay their eggs.

PRESSURES: Blue Crabs are bottom dwellers that filter feed from the detritus. Their feeding habits increase their chances of exposure to the contaminants that have accumulated in the bottom sediments.

LISTED IN THE FISH CONSUMPTION ADVISORIES: Yes

OF SPECIAL NOTE: Soft shell crabs (or shedders) are the crabs that have just recently shed their hard outer shell (exoskeleton). At this time they are vulnerable to predators while the shell hardens.

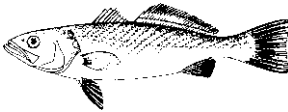
WINTER FLOUNDER

SEASONAL MOVEMENT: Winter Flounder are year-round residents that move from deep water to shallow water in the fall; they move offshore again in the spring, and spawn in the bay.

PRESSURES: Commercial fishermen take Winter Flounder offshore in the summer by trawlers and inshore in the winter by nets staked in shallow water.

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: When the water gets cold in the winter, flounder bury themselves in the mud. Like Fluke (Summer Flounder), the Winter Flounder's body structure changes as it grows older.

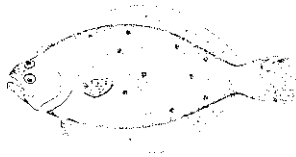
WEAKFISH

SEASONAL MOVEMENT: Weakfish have similar seasonal movements to Bluefish in that the species moves out to sea (and south) in the winter, while in the summer they move closer in to shore.

PRESSURES: Popular game fish

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: Weakfish are so named because they have a "weak" mouth structure that allows a hook to come out easily.

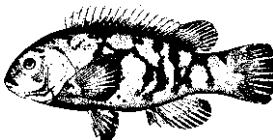
**FLUKE
(Summer Flounder)**

SEASONAL MOVEMENT: Fluke move from deeper water to shallower water during the summer months.

PRESSURES: Very popular sport fish.

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: A young Flounder changes from a "normal" looking fish to a flat fish early in its life. Its skull twists and one of its eyes migrates from the side of its head to the other side, so that both eyes are on the same side.

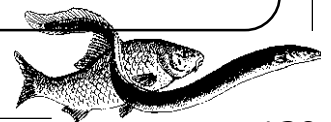
**TAUTOG
(Blackfish)**

SEASONAL MOVEMENT: Adult Tautogs move to deeper water during late fall. Here they overwinter and remain fairly inactive.

PRESSURES: Tautog is a bottom species; it is also a popular game fish.

LISTED IN THE FISH CONSUMPTION ADVISORIES: No

OF SPECIAL NOTE: The male of the species is extremely territorial.



COMINGS AND GOINGS – RESEARCH GUIDELINES

Discovery Sheet #18

Name: _____ Date: _____

Name of animal:

Description (size, coloration, other):

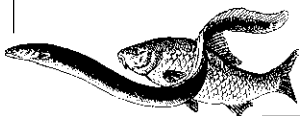
Describe seasonal movement or migration:

Life cycle information:

List preferred food:

Describe any pressures on the animal:

Interesting Facts:



CUTTING THE RISKS

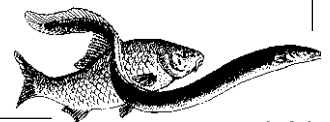
BACKGROUND INFORMATION

Fishing provides enjoyable and relaxing recreation. Fish are excellent sources of protein, minerals and vitamins and play a role in maintaining a person's healthy, well-balanced diet. Many people enjoy cooking and eating their own catch, but since 1982, when research began to show elevated levels of potentially harmful contaminants in certain fish and crabs in some New Jersey waters, advisories were adopted to guide anglers on safe consumption practices.

Fish that are used for food must be kept fresh until they are cooked, frozen or stored. Special cleaning methods can be used when preparing fish caught from areas that have a high incidence of contamination. These include skinning the fish and removing the fatty tissue (where contaminants concentrate) around the backbone, the belly, and the lateral line (along its side).

Blue crabs also contain these same contaminants, and in the Newark Bay Complex, it is prohibited to catch and/or harvest the crabs. As a general precaution, it is advised that crabs caught in other waters are prepared in such a way that the "green gland" or hepatopancreas is removed and not eaten. Water that the crab is cooked in should be discarded and not used in the preparation of other foods.

A popular alternative to catching and eating fish is to catch and release the animal. Anglers catch the fish, enjoy the relaxation and the thrill of the catch, but then immediately release the animal back to the water. Special equipment must be used for this type of fishing to reduce the risk of damaging the animal before it is released.



LEVEL

4 to 8

LENGTH

2 class periods



MATERIALS

- o Anatomy charts (Figures 15A and 15B)
- o Fish Preparation chart (Figure 15C)
- o modeling clay of different colors (enough for entire class)
- o a packet of pipe cleaners
- o a box of toothpicks
- o cardboard (one piece for each student or pair of students)
- o 1 fish specimen (with fatty tissue, such as bluefish or striped bass)
- o 1 fillet knife (for teacher)
- o plastic knives (one for each student)
- o newspaper
- o paper towels
- o plastic bag for disposal of the fish
- o water for cleaning up

OVERVIEW

Knowledge of fish and crab anatomy is necessary for cleaning and preparing them for human consumption.

OBJECTIVES

Students will be able to:



Identify the internal and external anatomical parts of a fish and crab;



Explain why certain parts of some fish and crabs should not be consumed;



Demonstrate preferred methods of fish/crab preparation.



ADVISORY LINK

The Fish Consumption Advisories outlines steps that an individual can take to minimize exposure to potentially harmful contaminants. By properly cleaning, skinning and trimming contaminated species, an angler can reduce the level of PCBs and dioxins in finfish.

KEYWORDS

anatomy
bioaccumulation
biomagnification
contamination

dioxins
fatty tissue
fillet
PCBs

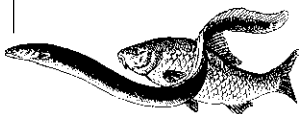
STUDENT PREREQUISITES

Safety practices when using knives

PROCESS SKILLS

communicating
observing
comparing

analyzing
synthesizing



PLANNING



1. Contact a local angler to demonstrate the proper cleaning methods to the class.
2. Obtain at least one fresh, not frozen, fish from the fish market and store it on ice for the demonstration.
3. Make copies of the Anatomy charts (Figures 15A and 15B) and the Fish Preparation chart (Figure 15C).
4. Assemble the art materials.

PROCEDURE SETTING THE STAGE

Name the parts of a chicken that you like to eat. What are the parts you don't like, but are still eaten by others?

THE ACTION



Period 1

1. Distribute the fish and crab anatomy charts to explain both the external and internal parts of each animal (Figures 15A and 15B). Discuss that blue crabs should not be caught and eaten from the Newark Bay Complex.
2. Introduce or review the concepts of bioaccumulation and biomagnification. Discuss what these terms mean with regards to fish. Identify the places where contaminants accumulate.
3. Provide each student (or pair of students) with art materials and cardboard.
4. Challenge the students to create an anatomically correct fish that includes the internal and external parts of the animal.
5. Set the models aside for the next day.

Period 2

1. Have a local angler demonstrate:
 - a. how the fish was kept fresh [*on ice*] and the importance of this step.
 - b. how to clean a fish by removing the fatty tissue that may contain the highest concentrations of contaminants. Distribute and reference the Fish Preparation chart (Figure 15C).
2. Instruct the students to practice cleaning their clay fish. Distribute plastic knives for the students to use.

CLOSING DISCUSSION

1. Describe the similarities and differences between fish and crab anatomy.
2. Why does the fish need to be prepared in a special way? [*The fish may contain contaminants from chemicals in the environment; special preparation reduces health risks.*]
3. Which parts of the animals need to be discarded to reduce the amount of contaminated food eaten? [*In fish, the fatty tissue along the backbone, the belly, its organs, and the lateral line*]



4. If a person chooses to eat a potentially contaminated fish how can he or she be sure that the animal has been cleaned and prepared properly? [*they can do it themselves; they can watch the person doing the cleaning, or a fish already cleaned can be purchased from a reliable source*]

ASSESSMENT STRATEGIES

Have the students:

- ☐ Draw a step-by-step schematic of the cleaning method.

STAYING INVOLVED



Have the students share their techniques for cleaning and preparing fish with their families or other students.

EXTENSIONS



Visit a fish market or seafood store for a guided tour.



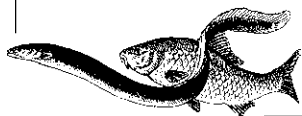
Go aboard a fishing vessel to see how the caught fish are processed and stored before going to market.

RELATED EDUCATION RESOURCES

- Aquatic Resources Education Curriculum
- *Project WILD*

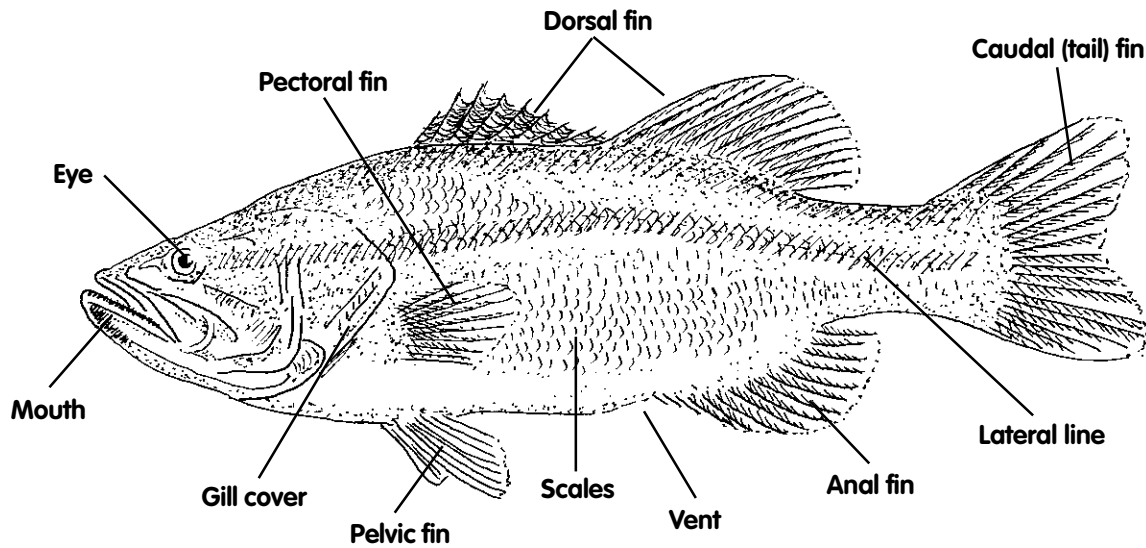
REFERENCE

New Jersey Department of Environmental Protection, Division of Science, Research and Technology. *Guide to Health Advisories for Eating Fish and Crabs Caught in New Jersey Waters*. 2004.

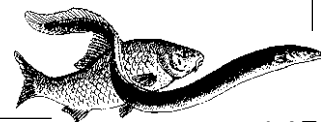
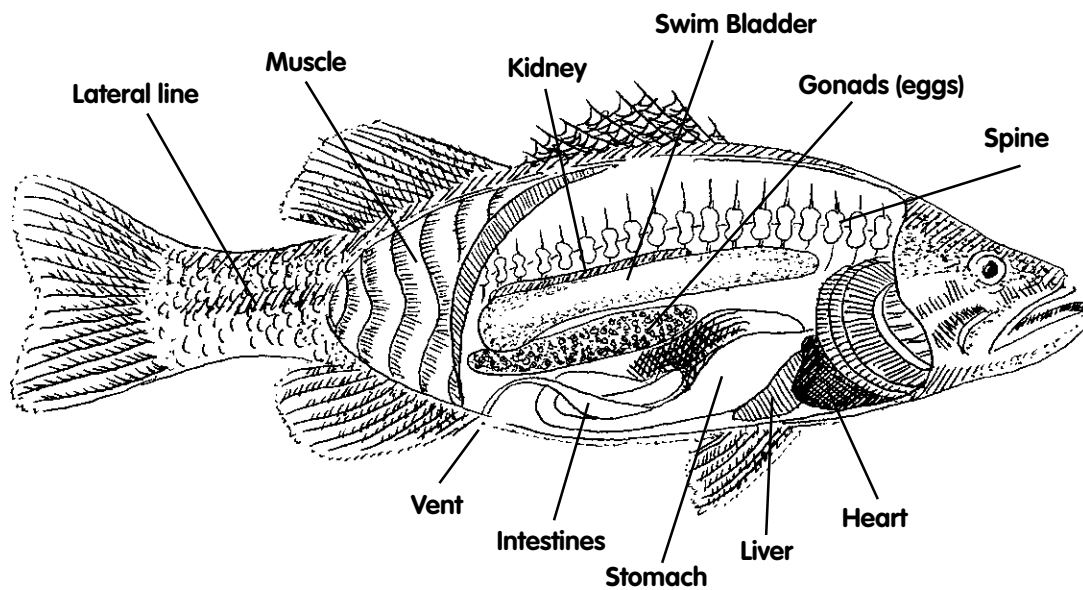


FISH ANATOMY

From the Outside:

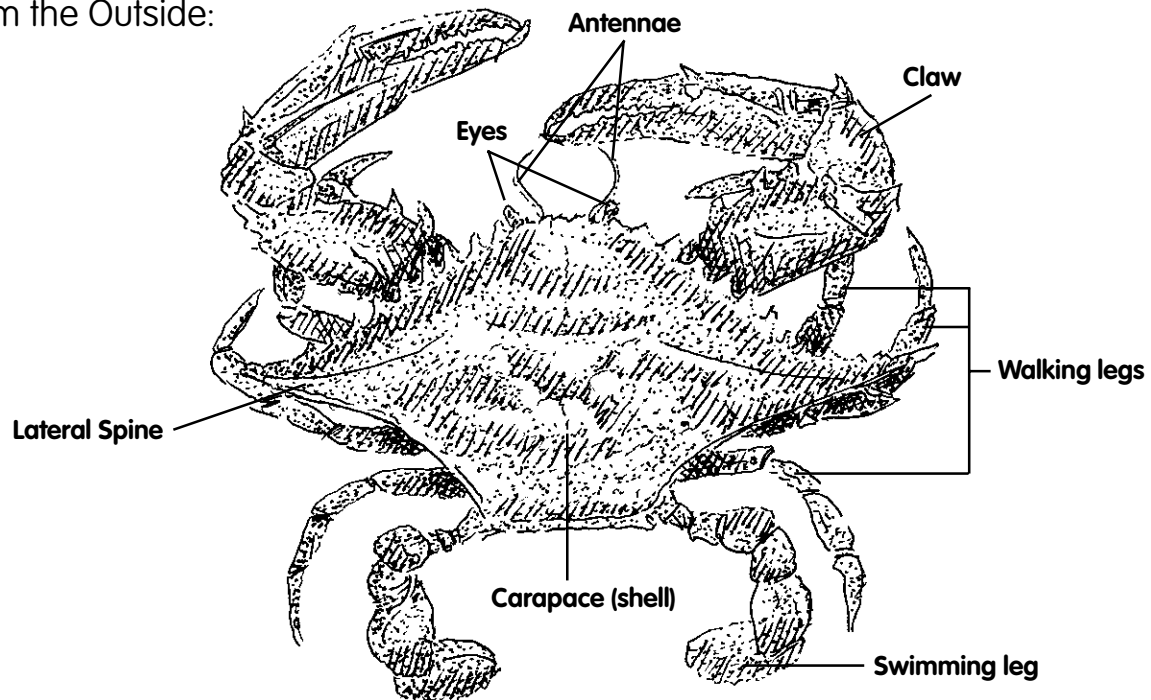


From the Inside:

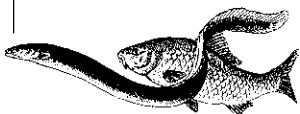
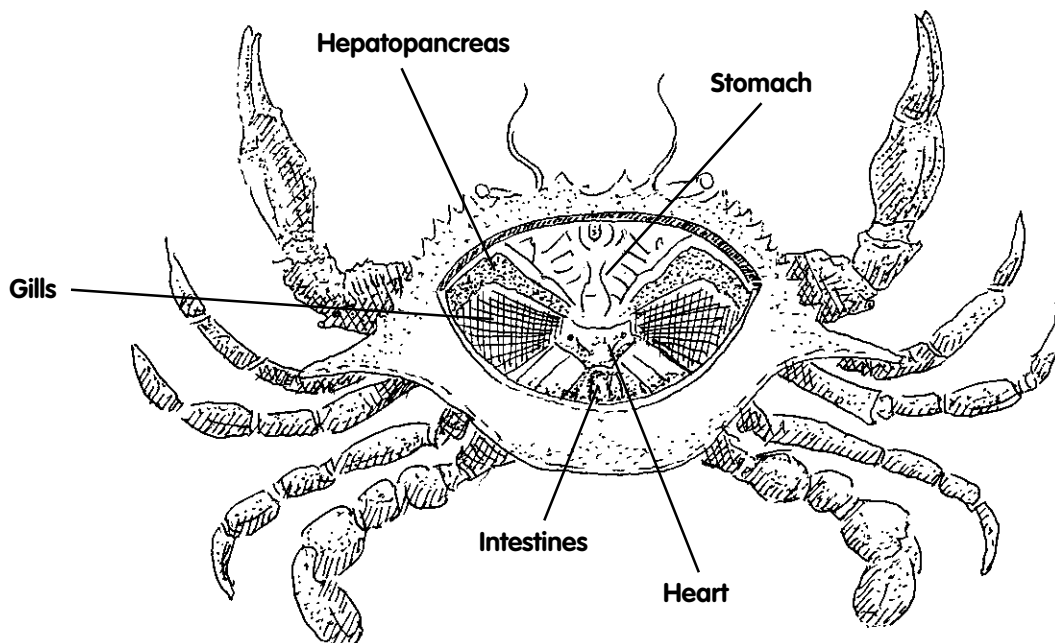


CRAB ANATOMY

From the Outside:



From the Inside:



FISH PREPARATION CHART

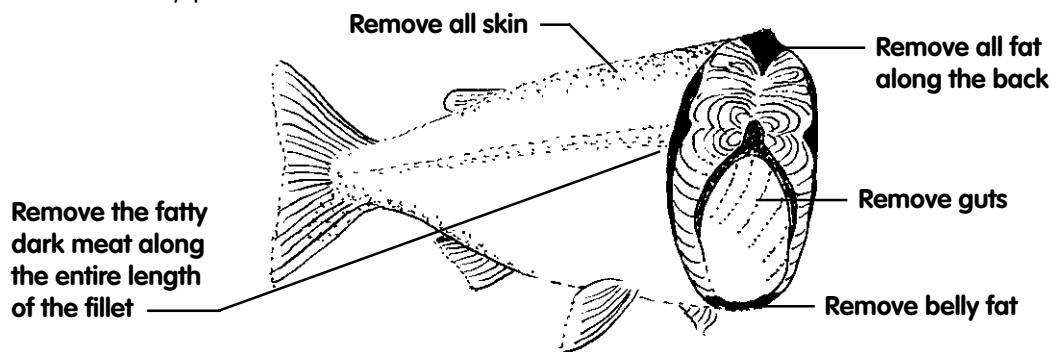
FISH PREPARATION METHODS

(From NJ Department of Environmental Protection, Division of Science, Research and Technology - <http://www.nj.gov/dep/dsr/pcb-advisories.htm>)

Proper fish cleaning and cooking techniques may reduce PCB levels approximately 50 percent when compared to raw fish fillets.

Eat only the fillet portions.

Do not eat whole fish or steak portions. Do not eat the heads, guts or liver, because PCBs usually concentrate in those body parts. Also, avoid consumption of any reproductive parts such as eggs or roe. Many chemical contaminants, like PCBs and pesticides (but not mercury), are stored in the fatty portions of fish. To reduce the levels of these chemicals, skin the fish and trim any of the dark meat (Lateral Line), back strap and belly flap. The following diagram illustrates those body portions.



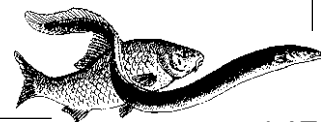
FISH COOKING METHODS

Use a cooking method such as baking, broiling, frying, grilling, or steaming that allows the fats and juices to drain away from the fish. When possible, cook the fish on an elevated rack that allows fats and juices to drain to the pan below. Avoid batter, breading or coatings that can hold in the juices that may contain contaminants.

The juices should be thrown away since they contain the PCBs and other chemicals that were in the fat. Do not pour these juices over the fish as a sauce or to moisten the fish.

Butter, margarine or other liquids can be added to the fish for this purpose once the juices have been poured off.

After cooking, **discard all liquids and frying oils**. Do not reuse. Do not use heads, skin, trimmed fatty portions in soups, stews, chowders, boils, broth or for fish stock. If you make stews or chowders, only use skinless fillet parts. Raw fish may be infested by parasites. Cook fish thoroughly to destroy the parasites. This also helps to reduce the level of many chemical contaminants.



NOTES

